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(54) **Improvements introduced in a combined refrigerator-freezer with three independent compartments**

(57) The refrigerator-freezer comprises a top A, a middle B and a bottom C compartment, such top compartment A being provided to operate as refrigerator, the middle compartment B being provided to optionally work as cellar, refrigerator, storage and freezer, and such bottom compartment C being provided to work as freezer and food preserver. The top and bottom compartment evaporators 2, 3 are related to each other and cold is generated therein through a single compressor with the assistance of a three-way and double-position electrovalve Fig 3, whereas cold generation in the middle compartment is effected independently with another compressor related to another like valve Fig 4.

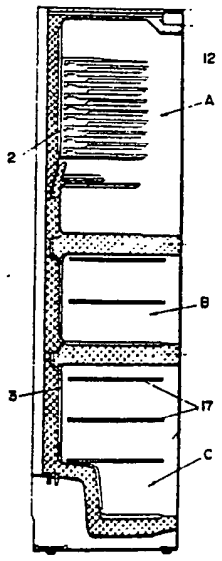

FIG-2

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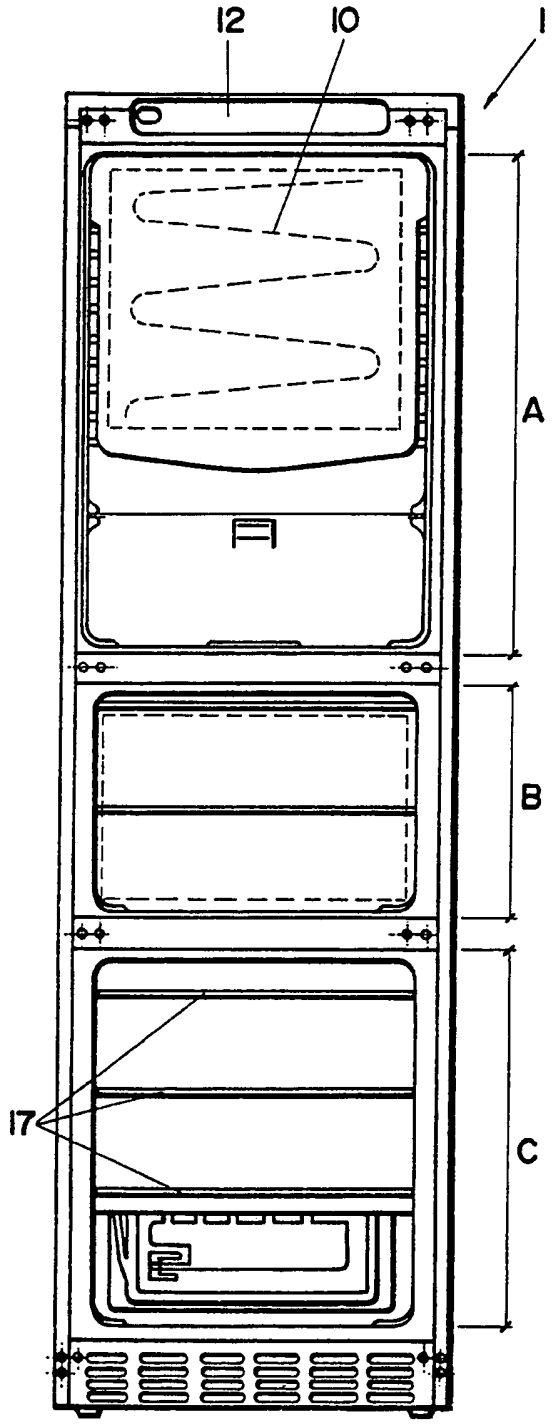


FIG.-1

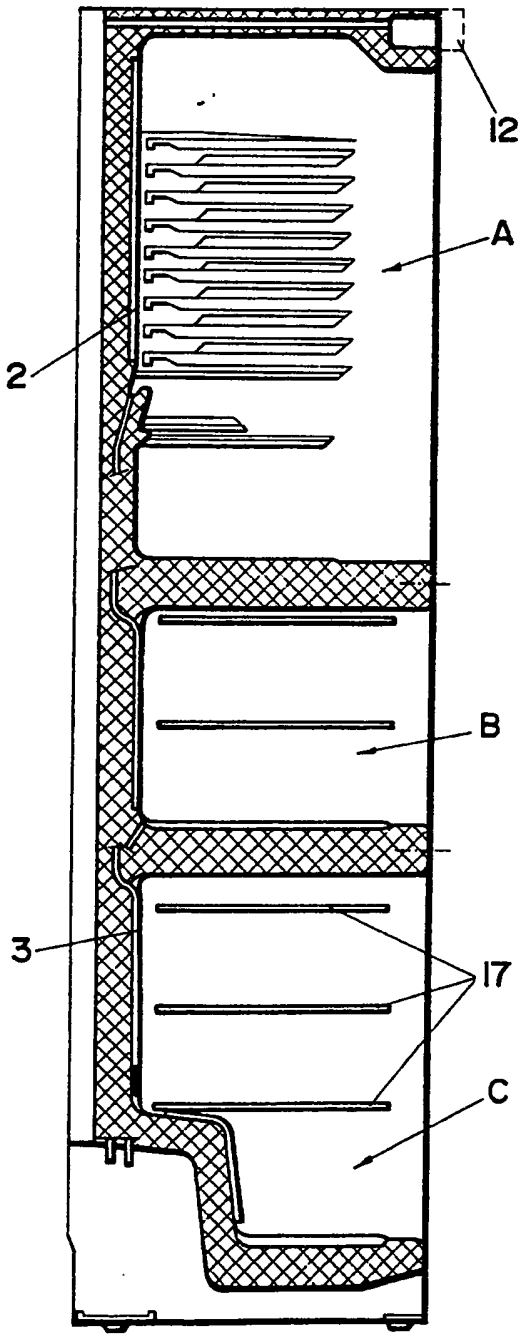
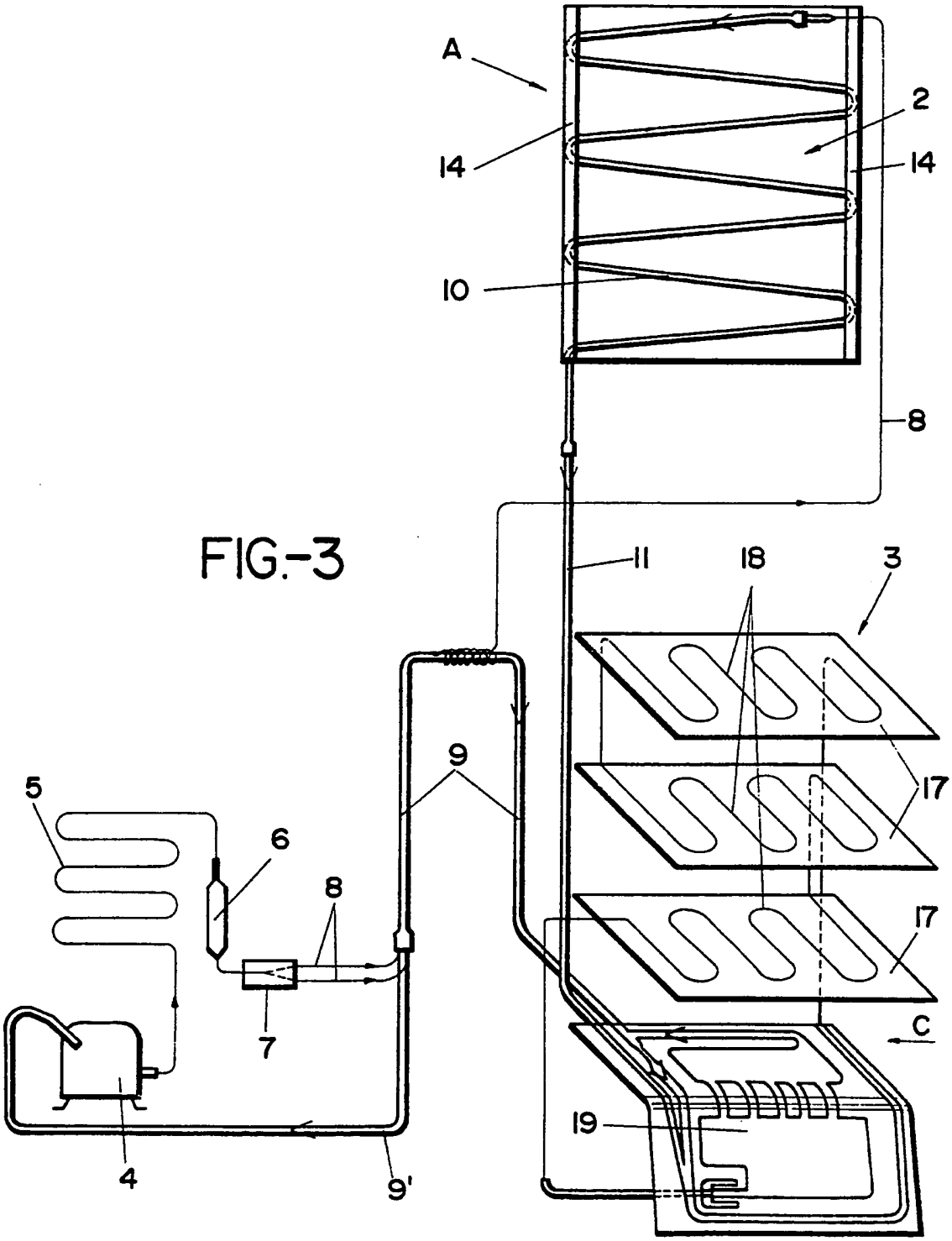


FIG.-2

FIG.-3



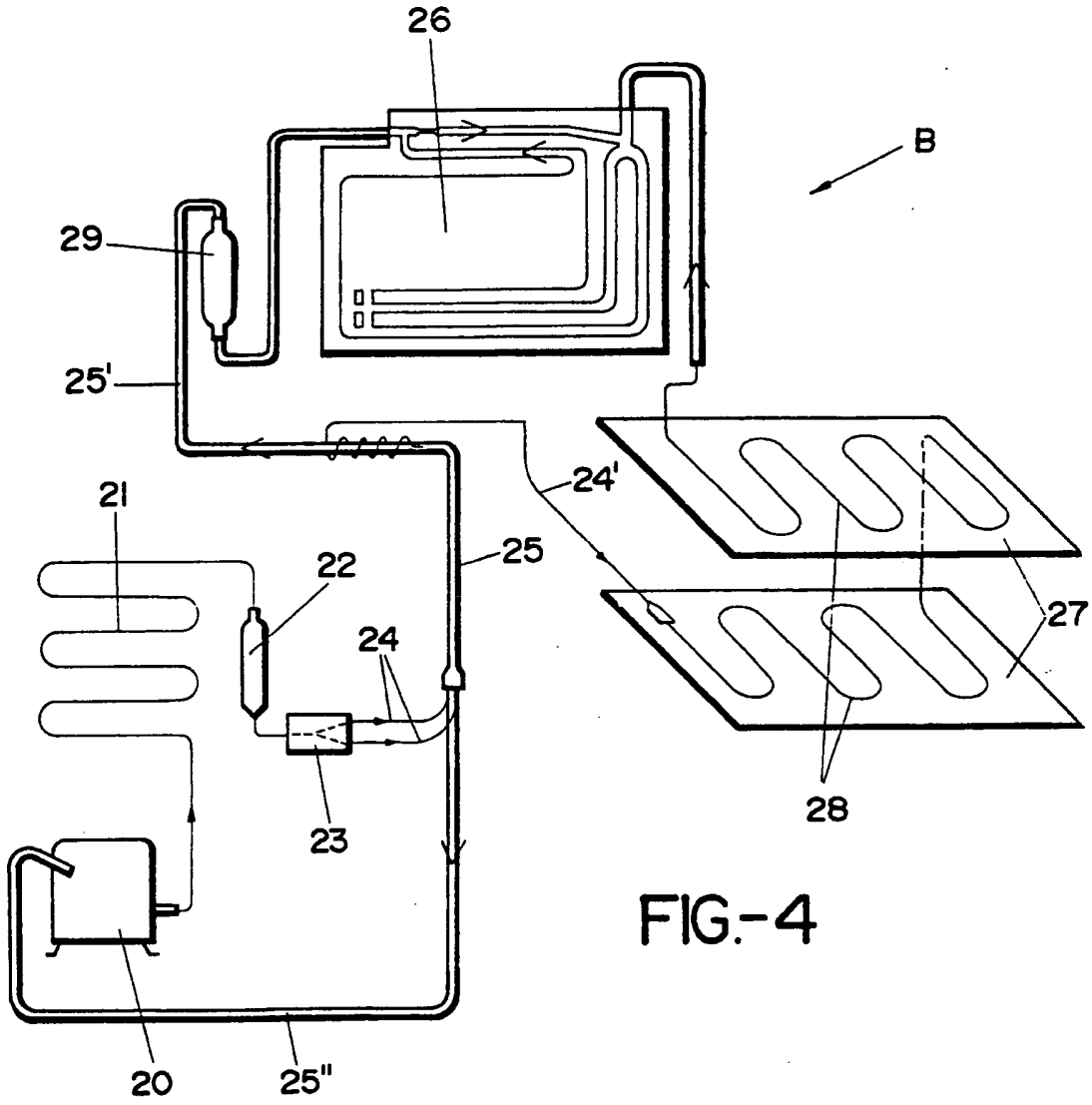


FIG.-4

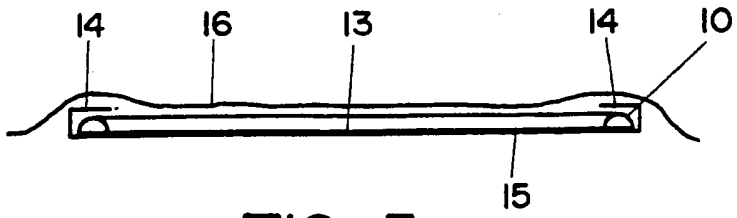


FIG.-5

IMPROVEMENTS INTRODUCED IN A COMBINED REFRIGERATOR-FREEZER WITH THREE INDEPENDENT COMPARTMENTS

SPECIFICATION

OBJECT OF THE INVENTION

The present invention relates to improvements in combined refrigerators-freezers having three independent compartments, one of such compartments being provided as refrigerating space for a temperature range of 0° to 5° C, the second compartment being optionally provided to reach temperatures ranging from 9 to 12°, deemed as cellar or cave temperature, also refrigeration temperatures ranging from 0 to 5° C, storage temperatures below -18° C and moreover to reach freezing temperatures of down to -24° C, the third compartment being finally provided to reach freezing and storage temperatures ranging between -24° C and -18° C.

Each of these three independent compartments is equipped with an evaporator, characterized in that cold generation in the first and third compartments is effected by a single compressor together with a three-way and double-position electrovalve, whereas cold generation in the second compartment is effected with an independent compressor and obviously with a similarly independent refrigerating circuit.

BACKGROUND OF THE INVENTION

A refrigerator-freezer with three independent compartments, viz. a freezer and storage compartment, a storage, refrigerator and cellar compartment and a third refrigerator and cellar compartment, is cited in European Patent no. 0192526, which refers to a refrigerating cabinet with three compartments having separate openings and being thermally insulated from each other, such compartments controlled by different thermostatic mechanisms. In this refrigerator-cabinet, the first compartment is provided for freezing and storing products, and

is cooled by an evaporator, whereas the second compartment may optionally operate as a storage, as a refrigerating and even as a cellar compartment, the third compartment being provided to operate as a cellar or as a refrigerating compartment.

According to these essential principles, each compartment in this refrigerator-cabinet can operate in a different mode to the others, and at least two compartments can work in the same mode and the third one in a different mode, thereby allowing any of the modes to be chosen.

Regarding the refrigerating circuits, this patent of invention provides that both the freezing and storage compartment and the optional storage, refrigerating or cellar compartment, are independent, and each is fed by a different motor compressor.

Moreover, the product storage and freezing compartment and the refrigerating and cellar compartment are fed by a single compressor and are obviously each equipped with an evaporator.

These refrigerating circuits and relevant electric circuits are combined so that when the three-mode compartment is used for storage, this compartment and the freezing-storage compartment have contemporaneous refrigerating needs, it further having been foreseen that when the said three-mode compartment is used for refrigeration, cold will only be generated therein when the first or refrigerating-cellar compartment has to be cooled.

The refrigerator unit is altogether obviously complemented with controls, thermostats and switches, and with electrovalves so that cold transmission to each evaporator is effected as established in the set requisites and programs.

Clearly, the refrigerator of European Patent 0101326, that has just been generally set out, yields a very good performance albeit

falling ill of given disadvantages, such as omission of the physical evaporator structure in each compartment, and coil assembling and actual shape thereof, important characteristics in a refrigerator, the unit of such European Patent moreover falling ill of an accumulator for accumulating the surplus refrigerating freon when the three-mode compartment works as refrigerator.

DESCRIPTION OF THE INVENTION

The improvements introduced in the aforesaid type of combined refrigerators-freezers with three compartments or spaces fully solve the problems and disadvantages of the unit subject of European Patent 0192526 mentioned as background, the improvements at issue focussing on the actual refrigerating circuit, construction of the evaporators, and some other details that will altogether make the refrigerator-freezer yield a maximum performance and an optimum operation.

More specifically, according to the improvements subject hereof, the refrigerator-freezer which will be provided with such improvements and also comprising three independent compartments is characterized in that one of the compartments may optionally take on four modes, reaching cellar or cave temperatures ranging between 12° and 9° C, refrigeration temperatures from 0° to 5° C, storage temperatures of around ≤18° C and freezing temperatures of roughly down to -24° C, the other two compartments being provided to operate as freezer-storage space for products and another as refrigeration space, respectively.

In order to overcome any description problems the refrigeration compartment will be hereinafter be referred to as top compartment, the freezing-storage compartment as bottom compartment, and the third compartment, or compartment with four different modes, as middle compartment.

In this sense, the top and bottom compartment evaporators are connected to each other and cold is generated therein by a single

compressor, with the assistance of a three-way and double-position electrovalve, the refrigerating circuit being related to relevant temperature controls and switches.

Thus, when the relevant temperature control detects the need for cold generation in the top compartment, the relevant electrovalve changes position to make the working compressor send the coolant toward the top compartment evaporator, so that once this evaporator has been traversed, it can continue toward the bottom compartment evaporator. Once the refrigerant has run through the bottom compartment evaporator circuit, the former will return to the compressor through the relevant circuit or exchanger pipe.

In the light of the foregoing, whenever the top compartment is being refrigerated so will the bottom compartment.

Nevertheless, further cooling might perhaps not be required at a given time in the top compartment, such circumstance being detected by the relevant temperature control that will, in turn, prompt the three-way and double-position electrovalve to change its position and send cold only to the bottom or freezing compartment.

The whole unit will obviously be equipped with controls actuated by the user, with a manual push-button among such controls to permanently cut off the cold sent to the top or refrigerating compartment, thereby allowing the freezer to continue operating to store frozen foods, for instance during holidays.

The top compartment evaporator preferably comprises a coil formed by a bead tube the flat part of which is attached to an aluminium plate with folded end edges defining a groove that houses the curved ends of the said coil, thereby guiding the coil tube and duly centering the same, moreover facilitating handling, storage and conveyance thereof.

In the middle compartment cold is generated or not as the user sees fit, and therefore when it is operating, its mode, viz. cellar or cave, refrigeration, storage or freezing, may be selected.

This middle compartment has its own compressor and a three-way and double-position valve and therefore in order to reach cellar or cave, viz. ranging between 9° and 12° C, or refrigeration, 0° and 5°C, temperatures the electrovalve will take up a given position, and an evaporating plate attached to the rear part of the middle compartment bottom wall shall be used, whereas in order to reach storage or freezing temperatures, the electrovalve will adopt the other position and the same evaporating plate and also the evaporating coil provided in the freezer shelves will be used.

The small dimensions of the middle compartment imply that the refrigerator evaporator volume destined to accumulate refrigerating gas, i.e., Freon (R TM), must be compensated with an additional accumulator, essentially due to the need to accumulate surplus freon when working in the refrigerator mode, as a consequence of the necessary surplus that must be available for whenever the freezer mode is required.

The sufficient accumulator is attained by means of the actual refrigerator evaporator accumulator, inserting an additional accumulator in the relevant exchanger tube, the latter being formed by two capillaries coupled to the electrovalve outlets, one of which leads the freon to the evaporator for cooling as refrigerator or cave, and the other to the freezer shelves evaporator coil, all the freon going back through the cooling evaporator as refrigerator or cave to the compressor. As aforesaid, the refrigerator circuit is specially characterized in that the bead tube on an aluminium plate constituting the evaporator defines the primary circuit of such refrigerator circuit, whereas the plate defines the secondary circuit. As the coil is attached to the aluminium plate, such coil's tube and the plate are in close contact, the former's curves being under the grooved shape defined on the plate edges, and therefore the coil is perfectly

centred and fixed, which favours the manufacturing process, moreover giving rise to greater overall rigidity and facilitating increased bead tube contact against the aluminium plate.

This unit is attached to the hidden part of the relevant container by means of an adhesive tape covering both sides of the unit all of which is subsequently covered with an aluminized polyethylene sheet.

DESCRIPTION OF THE DRAWINGS

In order to complement the description being made and to assist a better understanding of the characteristics hereof, a set of plans is attached hereto as an integral part of this specification, showing the following merely by way of a non-limiting example:

Figure 1.- Is a front view of a refrigerator-freezer with three independent compartments constructed pursuant to the subject hereof.

Figure 2.- Is a side elevation view of a vertical plane section of the same refrigerator.

Figure 3.- Diagrammatically shows the refrigerating circuit of the top and bottom compartments.

Figure 4.- Shows the refrigerating circuit of the middle compartment, such circuit being wholly independent of the top and bottom compartments' refrigerating circuit shown in the previous figure.

Figure 5.- Is finally a diagrammatic view of the shape and arrangement of each coil on the aluminium support plate.

PREFERRED EMBODIMENT OF THE INVENTION

With regard to the above figures, figure 1 is specifically a front view of a refrigerator-freezer cabinet 1 with three wholly independent compartments corresponding to the sections referred to as A, B and C, respectively, section A being the top compartment, section B the middle compartment and section C the bottom compartment.

The top section A is provided to act or operate as a refrigerator with temperatures ranging between 0° and 5° C. The middle compartment B is provided to optionally operate with four temperatures, viz. cellar or cave, ranging between 9° and 12° C, refrigerator, between 0° and 5° C, storage, roughly ≤18° C and also freezer at down to -24° C, whereas the bottom compartment C is provided to operate as freezer and at the same time as storage place, with temperatures ranging between -24° C and -18° C, respectively.

These three compartments, A, B and C, are wholly independent with regard to each other, specially characterized in that the top compartment A evaporator 2 is connected to the bottom compartment C evaporator 3 through the corresponding refrigerating circuit common to both.

Cold generation in both compartments A and C is effected through a single compressor 4 the outlet of which has been provided with a condenser 5, followed by a filter-desiccator 6, and then a three-way and double-position electrovalve 7 from which the capillaries 8 that traverse the relevant exchanger 9 emerge.

Operation is as follows:

When the relevant temperature control detects the need for cold generation in the top compartment A, the electrovalve 7 changes position impelling the compressor 4, in the direction of the arrow, i.e., through the condenser, filter-desiccator and the actual

electrovalve, to send the coolant toward the evaporator 2 through the relevant capillary 8, so that once the said coolant has run through the said evaporator 2 coil 10, it goes back through the return tube 11 toward the bottom compartment C evaporator 3, in turn traversing the latter's evaporator 3 and returning to the compressor through exchanger branch 9'. Therefore, whenever top compartment A is cooled, so is the bottom compartment.

Nevertheless, further cold might perhaps not be required at a given time in the top compartment A, such circumstance being detected by the relevant temperature control that will prompt the electrovalve 7 to change its position and only send refrigerant to the bottom or freezing and storage compartment C evaporator 3.

Similarly, a manual push-button provided in the corresponding control board 12, as shown in figure 1, can also be pressed to fully eliminate sending of cold to the top compartment A, allowing the bottom compartment C to continue operating as frozen food preserver.

Figure 5 shows the structure of the top compartment evaporator 2, with its corresponding bead section coil 10, so that its flat part is attached to a flat aluminium surface 13 with its two side edges 14 folded to form respective grooves specifically housing the curved ends of the said coil 10, that manage to guide the latter and suitably centre the same, moreover facilitating handling, storage and conveyance thereof. Furthermore, the unit so structured will be attached to the relevant container by means of an adhesive tape 15, provided for both surfaces and complemented with a heat disseminating and protecting tape 16.

Figure 3 shows, as aforesaid, the refrigerator circuit common to both the top A and bottom C compartments, which latter can be observed equipped with freezing shelves 17 traversed by the respective coil 18.

The lower part of the bottom and freezer compartment C, and as a complement to this compartment's general evaporator 3 shelves 17, has been provided with an evaporating plate 19 to reach a more uniform storage or freezing temperature throughout the bottom compartment, which plate is preferably roll-bond to facilitate the coolant's return to the compressor 4 through exchanger branch 9'.

The middle compartment B has an independent refrigerating circuit, with its corresponding compressor 20 the outlet of which has been provided with the condenser 21, followed by the filter-desiccator 22, and then a three-way and double-position electrovalve 23, from which emerge the capillaries 24 that go through the exchanger 25 into the evaporators 26 and 27 leading the coolant thereto.

Because this middle compartment B may moreover act as a freezer, it will be equipped with the relevant freezer shelves 27 and coils 28 thereon as in the top and bottom compartment evaporators.

The operating modes of this middle compartment B are solved manually from the control board 12, through the relevant push-button, so that in order to attain for instance cellar or cave or refrigeration temperatures, the electrovalve will take up a given position to send the coolant through branch 25' toward the evaporator 26, whereas for storage or freezing temperatures to be reached, the electrovalve 23 will take up the other position and the coolant will be sent through the capillary 24 to the evaporator formed by the shelves 27 and coils 28.

This middle compartment B refrigerating circuit has been provided with an additional accumulator 29 in view of the need to accumulate surplus freon when in a refrigerator mode, since there must be surplus coolant for when the whole unit must work in refrigerator mode, it having been foreseen that this additional accumulator 29 be inserted in the exchanger pipe, specifically in branch 25' shown in figure 4.

The coolant returns, irrespective of the mode of this middle compartment B, through the evaporator 26 toward the compressor 20, through the relevant branch 25".

The unit is obviously complemented with the relevant control circuit related to the temperature controls, electrovalves and, of course, the said compressors, and a series of knobs in the relevant board or control board 12 for selection of such modes as the user sees fit.

It is not considered necessary to extend the present description any further for an expert in the art to understand the scope of the invention and the advantages derived therefrom.

The materials, shape, size and arrangement of the elements may vary, provided this does not imply a modification in the essentiality of the characteristics of the invention.

The terms used to describe the present specification should be understood to have a wide and non-limiting meaning.

It will of course be understood that the present invention has been described above purely by way of example, and modifications of detail can be made within the scope of the invention.

C L A I M S

1.- Improvements introduced in a combined refrigerator-freezer with three independent compartments, one of such compartments designated as top compartment working as refrigerating space, another one designated as middle compartment optionally working as cellar at a temperature range of 9° to 12° C, as refrigerator with temperatures ranging from 0° to 5° C, as storage at around -18° C. and as freezer with temperatures down to -24° C, and the third one designated as bottom compartment working as freezer and food preserver, with temperatures at around -24° C in the first case and -18° C in the second case, the top and bottom compartment evaporators being provided connected to each other and cold generation therein being effected through a single compressor, with the assistance of a three-way and double-position electrovalve moreover related to relevant temperature controls, whereas the middle compartment evaporator is wholly independent of the other two and has its own compressor and a three-way and double position electrovalve, likewise related to a temperature control, all of this together with the corresponding electric control circuit and the control knobs for the user to select the modes of each compartment, such improvements characterized in that the top compartment evaporator coil has a bead section and its flat part is attached to an aluminium plate, with its end edges folded to form respective grooves housing the correspoding coil bends, the unit being complemented with adhesive tapes on both sides and a heat protecting and disseminating tape, moreover characterized in that the middle compartment refrigerating circuit has been provided with an additional refrigerant accumulator, inserted in the corresponding exchanger pipe, which additional accumulator accumulates surplus coolant when such compartment works in the refrigeration mode, such surplus being used when in the freezer mode.

2.- Improvements introduced in a combined refrigerator-freezer with three independent compartments, in accordance with claim 1, characterized in that the bottom compartment evaporator is

complemented with a special evaporating plate to reach a wholly uniform storage or freezing temperature in such bottom compartment, moreover facilitating inlet to the freezer evaporator and return of the coolant to the compressor.

3.- Improvements introduced in a combined refrigerator-freezer with three independent compartments, in accordance with previous claims, characterized in that the coolant from the common compressor to the top and bottom compartments may be sent either to the top compartment evaporator, returning to the compressor after going through the bottom compartment evaporator, or else be sent straight to the bottom compartment evaporator to similarly and directly return to the compressor.

4.- Improvements introduced in a combined refrigerator-freezer with three independent compartments, in accordance with previous claims, characterized in that the middle compartment refrigerating circuit coolant may be sent toward an evaporator to attain the cellar and the refrigerating mode, or else be sent to an evaporator to reach the storage and freezing temperatures, such coolant returning in both cases to the compressor through the first mentioned evaporator.

5. A refrigerator-freezer comprising top, middle and bottom compartments, the top compartment acting as a refrigerator, the middle compartment optionally as a cellar, refrigerator storage or a freezer, and the bottom compartment as a freezer and food preserver, and wherein the top and bottom compartment evaporators are related to each other and cold is generated therein through a single compressor with the assistance of a three-way two-position electrovalve, whereas cold is generated in the middle compartment independently.

6. A three compartment refrigerator-freezer device substantially as hereinbefore described.

7. A three compartment refrigerator-freezer substantially as described herein with reference to the accompanying drawings.

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